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The class of Web 2.0

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Active Collaboration Learning Environments: The Class of Web 2.0

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Abstract

The maturity and increased integration of online collaboration, networking, and research tools offer Information Systems faculty opportunities to provide unique learning environments at multiple levels. A growing ensemble of Web 2.0 technologies provide the background to introduce and explore fundamental aspects of information system development, design, application, and use, while simultaneously providing a functional suite of tools which will aid students in other aspects of their university learning. A selection of these technologies and case studies of their classroom usage is discussed. In addition, an agenda for research in both pedagogy and in information systems phenomena is outlined.

Keywords

Web 2.0, social media, situated learning, research agenda, integrating business knowledge

INTRODUCTION

Tell me, and I will forget.
Show me, and I may remember.
Involve me, and I will understand.
- Confucius, 450 B.C.

Advances in online collaboration and research tools have brought new challenges to faculty involved in developing and teaching Information Systems (IS) curricula. One challenge lies in teaching students the principles of information technologies and information processes which are emerging faster than they can be integrated into course material and textbooks. Concurrently, social networking tools (e.g. blogs, Twitter, Facebook, MySpace, Second Life), online collaboration and research tools (e.g. discussion boards, wikis, Zotero, Google Docs, Del.icio.us), and media sharing tools (e.g. Flickr, YouTube, Google Video) are all rapidly maturing and becoming readily available and integrated technologies. A second challenge appears as many of these Web 2.0 technologies are arguably gaining importance in work environments (Kane et al. 2009; Mcafee 2006) and knowledge of their development and use is becoming more salient to students in information systems and business disciplines. Finally, an additional challenge lies in the problematic integration of new technologies into a blended learning environment (Aspden and Helm 2004). Integrating technologies with traditional pedagogies is time intensive, asking students to access too many information sources or outlets may reduce participation, and avoiding superficial and trivial technology-based exercises takes imagination.

In this research we argue that despite these barriers, using these technologies as part of the overall educational experience provides a hands-on means of engaging IS students with the fundamental principles of the technologies they are using in an immediate and personal manner. Furthermore, knowledge of these tools, their integration and application may immediately benefit students who are engaged in multiple research and collaborative activities – their university education.

Today's students are familiar with the use of many social networking tools and may spend a significant amount of time involved with online activities. This familiarity with the operation of applications and their contextualized use provides an immediate grounding for learning numerous fundamental IS principles, theories, applications, and development procedures. At the same time, students are gaining experience with technologies whose analogues they will use in the workplace, which will have immediate benefits for their entire course of study. Many students dread 'group projects' because of the difficulty in managing time allocation, work distribution, exchange of versioned documents, and group availability of resources such as shared references, video, or presentations. In addition, many students receive no introduction to working in, or managing, groups or projects – it is merely assumed that they will "work it out," often to their frustration and educational detriment. But many of the available technologies were designed precisely for the kinds of coordination, collaboration, and group support they can use in their studies, thus providing a 'study-in-use' type of experiential learning. The objects of their intellectual engagement serve the dual purpose of exemplars of IS technology and principles and

also as tools that will benefit them immediately and for the remainder of their educational and professional careers.

The purpose of this research is to illustrate a range of available tools, provide case examples illustrating how they may be incorporated into the classroom and the challenges in doing so, and finally, to lay out an agenda for future IS research in the development, use, and educational value of these technologies. As such, this research serves as both an overview of the Web 2.0 landscape to jumpstart introducing these tools into the classroom and a as framework of potentially fruitful research questions for the study of effectiveness and outcomes of use of these technologies.

TEACHING WITH TECHNOLOGY

Interest in the use of technology in the classroom and lecture hall is not new, and an extensive literature exists largely in the education discipline. A full review is beyond the scope of this research, but recent work on blended learning environments (Aspden et al. 2004; Garrison et al. 2000) and application of technology in teaching (Hooper et al. 1995; Selwyn 2007) provide pedagogical arguments for utilizing information technologies as a component of teaching in general. From the IS discipline arises research and discussion of wikis in education (Kane et al. 2009), and the increasing use of Web 2.0 technologies in the workplace (Maged et al. 2006; Mcafee 2006; Wasko et al. 2005).

Many reasons have been provided for increased interest in teaching with technology: increased maturity of the application tools and platforms, greater availability of ICT in classrooms and access to low cost or free applications, the high cost of textbooks and the short relevancy of content, particularly in information systems subjects, and significant changes in the styles of action and learning by current technologically savvy students (Hanover 2009; Kane et al. 2009). Both personal memory and community memory are required in the support of ongoing learning. Community memory may come in the form of textbooks and case studies, but may be supplemented with class-created content on a wiki or blog, through shared resources, and through discussion boards. Individual memory traditionally is supported by individual note taking and more recently through power point presentations or distributed notes. But Web 2.0 tools can augment personal memory with online document and reference tools, making an individual's material accessible anywhere, through calendars and automated reminders, personal blogs or online journaling. Learning styles and problem based learning (Savin-Baden 2000) may also be accommodated. By personalizing the learning experience though multiple media forms, and the juxtaposition of types of knowledge including abstract versus concrete, textual versus pictorial, static versus dynamic, and two dimensional versus spatial, faculty can relate material to the students' own immediate experience (Te'eni 2009).

Although these considerations provide a valid rational for working to integrate technologies with more traditional teaching pedagogies, additional impetus comes from a growing desire from many stakeholders to transform education. One focus has been on using technology to increase engagement, refashion course activities and increase "student learning outcomes and contain costs by focusing on the redesign of large introductory university courses." (Hanover 2009 p 2). Research by the US National Center for Academic Transformation identified five general strategies to integrate traditional and technology enabled pedagogies (Hanover 2009 p 9):

- **Supplemental model**: traditional course structure is maintained but is supplemented with technology based out-of-class activities and ICT supported active learning activities in the class.
- **Replacement Model:** replaces some in class meetings with online interactive learning activities and substantive changes in remaining in-class activities.
- **Emporium Model**: All class meetings are replaced with an online resource centre with course materials and personalized help. Attendance may be mandatory oropen depending on motivation and experience of the students.
- **Online Model**: This model also eliminates all class meetings and supports learning through online, multi-media resources, commercial software, guided feedback on automatically marked assessments, and a variety of staffing options.
- **Buffet Model**: Each student customizes a learning environment based upon preferences, experience and background, academic or professional goals.

Although the selection of any one of these models is subject to staff and infrastructure resources, the key determinant may lie with student's motivation and interest, the faculty preference for maintaining familiar roles and routines in the class such as lectures and tutorials, or for taking a radical departure from the traditional learning environments many students are quite bored with.

A Case for Web 2.0 in Information Systems/Technology Classes

Use of these tools in classes reinforces three significant ideas relevant to IS students in particular. First is the sheer speed of change in the IT/IS domain. Many of the specific technologies students are taught in traditional classes are out of date or will be soon obsolete. This provides significant impetus to focus on the principles, and the fundamentals underlying IS rather than specific instantiations. For example, Web 2.0 technologies exhibit an important shift in perceived affordances (Greeno 1994) from the visible components of Windows, Icons, Menus, and Pointers (mice) to a new set of widely diffused technology affordances including Search, Linkage, Authoring, Tags, Semantic extensions, and Signals (Mcafee 2006). These represent important changes and trends in user expectations and interactions with technology that will continue to affect technology development, adoption, and diffusion. Introducing students to the plasticity and rate of change of the discipline they are entering may well enable them to expect and handle future change. Introducing first-hand the problems with adoption, diffusion, technological integration, change management, network effects and critical mass will provide them with essential personal knowledge of the challenges facing a knowledge society in the coming years.

Second, the ubiquitous use and interaction with computers is a major driving force for business and society. As students see first-hand the changes from a "product view" of designed technologies (McKay et al. 2007) to a more interactionist and value-laden perspective on technology (Dourish 2001; Hovorka et al. 2008), they will be able to better comprehend the benefits, issues, and problems with of contextually situated application of technology in practice (Ciborra 2002; Suchman et al. 1999).

Finally, in-class use of these technologies grounds discussion of broader organizational concepts often glossed over in technology intensive classes. Universities tend to organize subjects "in terms of discipline (business economics, industrial sociology, occupational and organizational psychology) or functional orientation (operations, marketing, finance, HR)" (Tranfield 2002 p. 409). Often each discipline operates as its own cost centre and is presented pedagogically as 'the most important' to students (Hovorka et al. 2009b). But industry requires highly integrated and functional knowledge such that a greater degree of contextualiztion of IS principles will likely benefit students in their careers.

Majchrzak (2009) notes that for the "IS field to advance, researchers should try innovative technologies and practices" (p 18).Teaching with innovative technologies provides closer connections to technology savvy students, but also provides researchers with first-hand experience with the technologies. This may engender new research ideas. There exists an increasing array of Web 2.0 tools which can be brought into the classroom and it is critical that they are treated as both useful tools and as matters of scholarly pursuit. The interactions and uses of the tools provides grounding for class discussion (and research potential) on a multitude of organizational, management, group dynamics, and systems thinking theories. Rather than constraining the learning experience of students to the narrow silo of IS/IT knowledge frequently presented in textbooks, the study-in-use of technologies begins to bridge the gap between IS and business disciplines. For example, numerous theories inform research on the adoption, adaptation, communication, and group dynamics of wikis, including adaptive structuration, social identity, social capital, and apprenticeship, (Majchrzak 2009). Te'eni (2009) notes that many organizational behaviour and culture issues surround the applications of wikis for knowledge transfer and management. These include critical mass, sensitivity regarding ownership versus the desire for anonymity, and unease for making unfinished work public. In addition, theoretical aspects of knowledge sharing (Boland Jr. et al. 1994) and incentive structures (Nahapiet et al. 1998), technology tailoring (Germonprez et al. 2007; Hovorka et al. 2009a), and communication breakdown and resolution (Germonprez et al. 2009) can be discussed in the context of in-class use of Web 2.0 technologies. Numerous other technology management, organizational behaviour, and communication principles and theories can be introduced as students use Web 2.0 technologies in the classroom. Casting these theoretical lenses on their own situated, first-hand activities may enable students to better understand the real world issues, problems and opportunities of IS deployments and the broader impact of IS within organizations and society.

But our fundamental premise in this research is in alignment with the view that we must change the "way in which knowledge is perceived: not as something that is reliable and changeless but as something that is an activity, a process of finding out" (Savin-Baden 2000 p 4). Problem solving provides a tension that creates a "readiness to perceive and to act...to make sense of its own situation both intellectually and practically" (Polanyi 1958 p 120). But beyond the value of experiential learning (Dewey 1938; Kolb 1984) we wish to emphasize the opportunity provided by Web 2.0 tools to help ground knowledge in action and to discern the integration of information systems with the broader operational, cultural, and behavioural systems which constitute the organizations in which IS is embedded.

A BRIEF HISTORY OF ALMOST EVERYTHING WEB 2.0

Wikipedia claims that the term Web 2.0 was first used by Darcy DiNucci (DiNucci 1999) to signify a web site that facilitated communication and information sharing amongst a user community. In the same year, Microsoft introduced the world's first widely used Web 2.0 application in Outlook Web Access as a web client for the Exchange mail server. This was made possible by the XMLHttpRequest API call integrated into Internet Explorer 6, and now standard in all web browsers. This API has become the heart of interactive web site technology (named AJAX in 2005) and marked a new era for the web.

The Transformation from Passive Recipient to Active Participant

In hindsight, we can differentiate between the Web 2.0 and its predecessor (now referred to as Web 1.0) based on the model of user interaction and engagement. In Web 1.0 the passive recipient used a web browser to search and display static web pages of information with no opportunity for information enrichment. Information flowed from a web page prepared by a human publisher to the passive reader. Web 2.0 is qualitatively different in engaging the user to become an active participant in information construction, transfer, and management. A Web 2.0 site allows a reader not only to accept the web page content but can provide a mechanism for comment, feedback and the submission of new, related information which enriches the page content. The reader becomes a secondary designer of the content (Germonprez et al. 2009) in an ongoing collaboration with the original publisher.

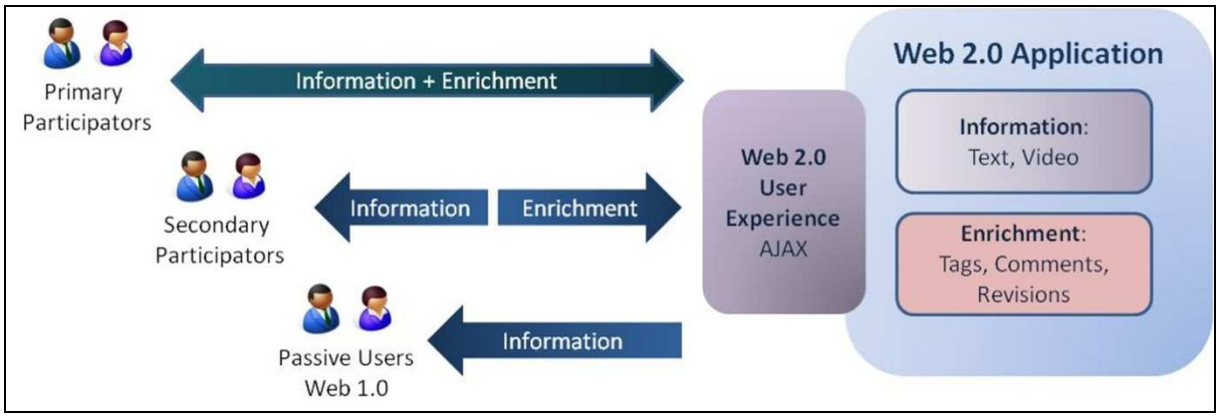

Figure 1. Transforming Interaction

The full flowering of a Web 2.0 site is reached when readers and publishers are indistinguishable. All users of such a site can be both readers and publishers and the contents of web pages are created in a truly collaborative manner and evolve over time keeping the information current. Wikipedea is an example of a successful large scale collaborative knowledge base created largely by volunteers. Each page entry represents the collective discourse of the original post from a published as edited and tailored by readers.

A Compendium of Web Tools

In the decade since its birth Web 2.0 technology has been used to build a wide range of interactive tools accessed via the browser. The sheer number of tools forces us to assign them to categories that we define below (for a more comprehensive list see CyberSmart 2009). Because this paper discusses the use of Web 2.0 tools for teaching and learning, we include only relevant categories and assign to each category the pedagogical benefits that tool offers (Bartlett-Bragg 2008). We concentrate on 'pure' Web 2.0 tools that require only a standard browser to deploy, and thus can be used from any Internet-connected machine at any location. Several of the pure Web 2.0 tools now also appear under the banner of social media. Many useful tools for class communication rely on client applications that must be downloaded and installed to operate. These we exclude on the grounds that they require a specific software environment often on a specific hardware or operating system platform.

Table 1. Web Tools Categories and Educational Activities.

Tool Category	Feature List	Educational Activities
Blogs	Provide a list of relatively short journal entries (posts) arranged in reverse chronological order. Post contents can contain rich media and can be formatted as reports, articles and new items. The blogger can choose post categories for providing	Community building, simple conversations, knowledge sharing, mentoring, reflection, peer review and the making

Tool Category	Feature List	Educational Activities
	information structure. Each post can allow readers to enter comments for feedback, information enrichment and discussion tied tightly to the original post.	and sharing of resources
Wikis	Provide a multiple-page web site where a community of users can each easily edit the content of existing pages, add and delete pages, and dictate the navigation links between pages to create site structure. A key point is that the human publishers need little or no skill in the detailed markup and styling usually required to construct and publish a useful web site.	Co-authoring, collaborative research, knowledge sharing, peer review, resource making and sharing, documentation and meta-data
Social Bookmarks	Provide one or more collections of hyperlinks to useful resources with useful descriptions attached to each hyperlink. Tagging allows a single account to accommodate multiple collections that tie directly to teaching subjects.	Collaborative research, community building, knowledge sharing, peer review, resource making and sharing, curriculum creation
Social References	Provide access to online libraries of shared academic references for use in reports, articles and assignment papers.	Collaborative research, knowledge sharing, resource making and sharing
Surveys	Provide a mechanism to gather factual data, comments and feedback on many aspects of curriculum and teaching and learning activities.	Knowledge discovery, statistical analysis techniques, feedback analysis
File Sharing	Provide a public and community-based private sharing of data files and documents of all kinds.	Co-authoring, collaborative research, knowledge sharing, resource making and sharing
Online Community	Provide class communications facilities that may be synchronous or asynchronous, and range from text-based to virtual 3D worlds.	Community building, conversations, mentoring, discourse building

USE SCENARIOS

We present here personal examples of the use of Web 2.0 tools that have supported teaching and learning of information technology and systems. Each example highlights the benefits and disadvantages that were found in practice and suggests how any limitations could be overcome. The agenda for research brings the limitations together into a cohesive series of projects to optimise the benefits of Web 2.0 in the educational context.

Blogging for Assessment

Blogging has been included as a component of the assessment for information technology subjects whose topics are centred on Internet technology and web applications. Initially a voluntary assessment choice for Masters students, the blogging assessment soon became compulsory for all students and the weight increased from 3% to 10% of total marks. The preamble and substance of the blogging assessment description provided to students lays the groundwork for the philosophy behind blogging and its utility to student learning.

This was inspired by Stutzman (2006) who claims:

> Fundamentally, blogs are communication tools, ones that when used in context become powerful tools for digital learning. Many in academia have effectively leveraged blogs to share their work and connect with students and colleagues, all the while spurring conversation and research.

A example teaching philosophy for blogging states:

> This assessment aims to introduce the class to the benefits of blogging for recording additional learning resources, your own thoughts and ideas, and achievements throughout the semester. It is hoped that each student will continue to use blogs into the future as this communication and recording mechanism is fast becoming a required life skill for both professional and social purposes.

To convince students of the benefits of blogging the assessment states:

> When maintained successfully a blog can become a valuable professional record of a person's activities. That blog can be leveraged further when preparing resumes and electronic portfolios of learning achievements. Another major use is for journaling key events and decisions in a timeline that forms the basis of reports and summaries.

While a simple blogging engine is usually available within the confines of an institution's learning management system this is often limited to access within a single class thus reducing intellectual interdisciplinary applications. This restriction also prevents the use of public, online blog aggregator tools like Google Reader which needs public access to the blogs being read. In addition, public blogging engines like Wordpress (http://wordpress.org) and Blogger (http://www.blogger.com/home) often offer better editing, commenting and categorising tools. Comments, advice, and resources on writing style have also proven to be very necessary:

> The blogs you will create are public and can be accessed by family and friends, and, of course, by anyone else on the Internet. While you are encouraged to write informally you are also required to use appropriate language. Treat your blog as a professional space, but one where you can also let your hair down as necessary.

Blogging assessments have been used in subjects taught over 6 semesters. A series of refinements has resulted in an assessment model that consists of two types of blog posts:

1. Defined blogging task: here a short description is given of the content of the blog post. In most cases the student is asked to read one or more online resources such as other blog posts, news items, technology descriptions on topics of relevance to the subject being taught. Usually the topics extend the syllabus and require the student to summarise and form an opinion on the effectiveness or otherwise of the topic.
2. Personally chosen post: here the student is free to choose any topic, but they are encouraged to make it relevant to their degree discipline, study and recreational activities or an opinion of a topical event, news item, piece of software or hardware, movie, and so on.

Over the course of the semester students are required to submit ten posts in each category consisting of about 5 paragraphs or more. Inclusion of images, audio and video is encouraged, and many students from overseas often include photos of their activities for family and friends. A useful side effect is that their families have exposure to some of their academic studies even if the subject matter is opaque. Commenting on other students' posts is encouraged but carried no marks. Thus comment activity was usually low despite its obvious benefits for peer review.

This approach to blogging assessment results in about twenty blog posts per student to be inspected over a period of twelve weeks. Using a blog aggregator like Google Reader makes the task straightforward. After the usual initial spurt student blogging activity usually falls off. An attempt to counter this by highlighting key posts of the week in class requires significant additional work by the instructor and only appears to incentivise the keener students. Despite constant reminders students tend to leave posting to near semester's end and therefore fail to introduce blogging into their weekly routine.

On the other hand there have been a number of positive outcomes such as:

- Motivated students are stimulated by the knowledge discovery process of creating posts from the set blogging tasks, even to the extent of creating more posts than needed for assessment
- For the self-chosen posts students often write about their reflections on their studies across several subjects and record problems and achievements; much of this information can be employed by the instructor to adjust formative assessments
- Student observations on the technologies within the set tasks build an additional knowledge base and can inform the instructor on curriculum changes either immediate or stored for future use
- Students facing significant problems with their studies can often be identified from their posts earlier than the typical mid-semester assessment results

It is time to move from the single, end-of-semester deadline for the blogging assessment to more frequent deadlines such as every 4 weeks. This should even out the blogging work and establish a routine.

A more important advance would be a central aggregation of the blog posts into a 'river of news' format. This would allow a community building process to be emphasised rather than relying on individual students reading

the posts of their class colleagues. A dynamic page on the subject LMS site using widget technology or scripts would be needed.

Microblogging in the form of the Twitter service is opens up a further opportunity to capitalise on some of the blogging benefits but in a more immediate and engaging format from a students perspective. A small demonstration of principle has been conducted by establishing a class Twitter account. Each student befriends the class account and thus receives all messages (tweets) that originate there. This constructs an immediate one-way communication for class announcements, alerts, reminders, special events and the like. Since each tweet is limited to 140 characters only small messages are possible yet are large enough to contain a link to a class web or wiki page for example. A huge benefit is that Twitter clients exist for many mobile phones and introduces a possible mLearning tool. Students can respond by using the Twitter reply mechanism so that acknowledgements, information responses and simple voting can take place. Once again the class Twitter stream needs to be integrated into a central aggregator alongside the blogging-river of news.

Wikis for Curriculum Development and Tuning

Wikis, like blogs, have been around for over a decade, and offer the ability to evolve a body of knowledge held in linked web pages with built-in editing, tagging and inter-page navigation capability. In the education context three productive use cases are:

1. An instructor uses a wiki for presenting core curriculum material that may evolve over the life of a subject. Only the instructor has edit rights and the students use the wiki for reference and revision.
2. Whereas the main contents of the curriculum wiki may only be edited by the instructor, the students are allowed to comment on each page. This allows students to provide feedback on the curriculum content and note omissions and difficult components, as well as fostering a sense of student ownership of the curriculum.
3. The instructor and students all have full editing rights including new page creation. This gives students significant input into the shape of the curriculum content, helps foster a class community and can provide a curriculum resource for future use.

Publically available wikis (e.g. pbworks.com, wetpaint.com, sites.google.com) offer password-protected access but are not the only option. Many universities have Learning Management System (LMS) in use, which offer a basic wiki building block that allows one or more wikis within one subject. This type of closed wiki is not a disadvantage provided a suitable export/import capability is available to allow the wiki 'object' to be transferred between subject sites.

Wiki use cases 1 and 2 are straightforward and are becoming commonplace. A demonstration of use case 3 revealed some interesting problems and benefits. At the start of semester, a curriculum is proposed in a top level outline with some early content filled out to a substantial degree to act as an exemplar. In early weeks of the subject students are split into groups during a class and asked to discover online material to fill out set curriculum components. A spokesman from each group then summarises the topic in a presentation to the class using the wiki page contents as 'slides'. A final group exercise in class asks for new, related topics to be found, written up and reported. The intention is to create a jointly developed subject curriculum with supporting resources that might be considered an open educational resource in its own right.

Some hard lessons were learned:

- Study groups found it difficult to collaborate in a class in class due to technological limitations. In this case one workstation was shared by a group of 4-5 students. Although the students could use their own laptops, students who were not 'at the keyboard' felt marginalized.
- Students forgot about the shared updating available for the wiki which should allow for the division of labour in insertion and updating.
- Overall the groups found difficulty in structuring topic reports and the level of detail was poor (either too much or too little).

Nevertheless the experiment was beneficial at giving students the impression they were having some effect on the topics they studied and engendered a sense of community. Our earlier comment on the need to introduce students to group working came to the fore here. When repeating this class work, some training will be needed in how to maximise the use of a wiki with its inherent collaborative properties when working in groups.

While very flexible, wikis are limited to storing information that can be displayed on web pages. However, educational material also includes specialist documents, media and datasets that at best can be linked from web

pages. An online file management system is needed to supplement a wiki. Google Docs (docs.google.com) is the leading example of a public, online storage service for special documents. Even though Google Docs is public, the sharing model allows for storage of documents with access limited to the individual or shared with a nominated group of individuals.

Document sharing by groups of students is supported by traditional LMS such as Blackboard. However, the establishment of group pages is tedious and falls to the instructor. Students use their own accounts when accessing Google Docs and can organise groups themselves in a timely manner.

Once the students have uploaded or created files on Google Docs they are retained beyond the normal semester constraints of an enterprise LMS. Thus the students automatically retain access to their documents to become part of their life-long e-portfolios. For assessment purposes the student may grant the instructor access to their files who can add marks and assessment feedback without the need for elaborate assessment submission procedures. The instructor can take copies of the Google Docs files where needed. Thus Google Docs has benefits that allow document creation, edit, fine grained sharing (e.g. groups, project teams), even with non-student users (external project collaborators). Again these public online Web 2.0 services exist as island services that must be drawn into a cohesive whole class communications and support environment.

Social Bookmarking

A significant component of educational materials supporting every subject is the set of links to online resources. Over the course of a semester this link component is usually the most volatile, especially with the appearance of new links. It makes sense to employ the features of a social bookmarking site such as the standout Delicious Web 2.0 application (delicious.com). In addition to listing the URL and simple title, Delicious allows a notes field, set of tags and privacy flag to be associated with each link. Tags and tag combinations then allow a link collection to be structured in a variety of useful ways for supporting teaching and learning:

- Majors and minors can own their own tag to allow sharing between subjects
- Each section and subsection of an individual subject syllabus can use its own tag
- Different types of links can be tagged appropriately
- Sharing of link collections can be extended to the students themselves

The subject code plus a short date-based suffix becomes a useful tag which works well in the Delicious environment. As an example, our Information Technology (INFT) subjects are designated by tags in the form of 'INFT232-063'; the subject code in 2006 during semester 3. Given the inft232-063 tag, students can be shown how to construct the final URL as http://delicious.com/tag/inft232-063. Normally this link would be displayed prominently and conveniently on a subject web page. Experience from practice shows that when the number of links starts to increase beyond 15-20 then additional tags should be used to define link subsets. For example when assigning a tag of "ajax" the URL for the ajax subset is simply http://delicious.com/tag/inft232-063+ajax.

To allow students to share in the creation and updating of a link collection, a Delicious account can be created with the password being shared with the students. They then share the management of the links collection for the subject. Once again, with no marks as incentives, students were not active in updating the bookmark collection, appearing to prefer to use wiki pages to gather links in situ with curriculum material. The Delicious URL given above and its associated links collection lives on to this day and has essentially become a small open educational resource in its own right. Delicious allows the tag author to add a tag description which essentially adds metadata to describe the tag and its intended purpose.

Delicious and similar link bases are very powerful managers of link collections but form a data black hole. Students might occasionally use the link base for reference and revision purposes and become part of a link community that has been created for them. However in practice students appear to be reluctant to contribute new links and take the time to tag them appropriately. Were the link bases to be a more prominent part of a central class communications hub their community-forming value might be realised.

Summary of Lessons Learned

Our informal demonstrations using Web 2.0 for teaching so far have largely concentrated on the various tools which, to reduce disruption, have been introduced in small classes following the Supplemental Model. Once marks are awarded for using Web 2.0 tools such as blogs and collaborative wiki curriculum planning then we moved in to a small-scale use of the Replacement Model. Being a private institution with immodest student fees it is unlikely we will move to adopt the Emporium or Online Models. However to allow maximum flexibility and to leverage the collaborative benefits for learning we would like to introduce aspects of the Buffet Model.

Some of the main problems encountered with the Web 2.0 tools involved the students engaging with and managing two or more silos of information. When collaborating the class needed multiple accounts to access the Web 2.0 tools as well as their university account for the LMS. Switching information contexts was often confusing and students frequently had difficulty deciding which context to contribute to. A way to structure threaded discussions and multiple blogs is a valuable area for future research. More importantly an integration mechanism is required to give the instructor and students the impression of a central learning hub from which the Web 2.0 services can be perceived (Figure 2). This is not a centralized architecture as the distributed nature of the tools precludes that. Rather it is a centralized view or "dashboard" from which users can obtain announcements, updates, access or contribute information. This type of integrated view would reduce some of the problems associated with a 'balkanized' suite of separately accessed tools. Some integration technologies such as Really Simple Syndication (RSS) and OpenID exist may be brought to bear to provide a solution.

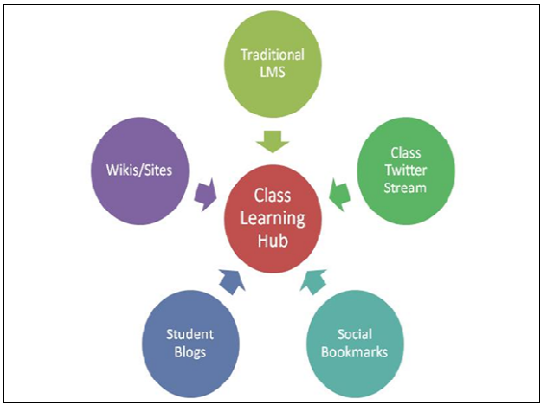

Figure 2 Perceived Integration of Web 2.0 tools

All of the Web 2.0 tools fostered collaboration and the students mastered the features of the tools in a short time. By engaging the material and contributing their own thoughts, specific information, and criticisms, students are part of the activity of knowledge and the process of its creation. This brings us closer to a embodied, visceral *learner-directed* learning (Richmond 1993). Students are also keenly aware of the public exposure of their contributions (public at least to the class) so their interactions with interfaces, editing tools, and access are issues that really matter. This is often not the case with exercises involving "artificial" academic exercise which they may have more difficulty relating to. Where the students found difficulty was in the appropriate application of the tools when working in teams or simply on their own initiative, information handling, and time management. All of these problems are to be found in their future working environments in an organisation and when working for themselves. Thus in introducing the Web 2.0 tools into their everyday learning we are equipping them with skills for their careers. Our future research agenda addresses both the technological challenges and the teaching of life management skills.

DISCUSSION

This exploratory research echoes the call for further application and research in the use of readily available Web 2.0 tools in the classroom to enhance teaching and learning. These tools allow more flexibility and often more functionality than the enterprise leaning management systems in place at many universities. This research contributes in three ways: First, by providing exploratory 'mini-cases' of three applications in use, we provide a context for their application in classroom environments. This will help overcome some of the hesitation and questions of how to engage students by having them use the technologies they are studying for their own work. Second, we suggest that the in-situ use of collaboration and communication tools that are currently infiltrating the workplace provides a unique grounding for discussion of a wide variety of organizational theories and principles. This provides a better integrated view of the role of information systems in the real world and introduces many of the issues faced by knowledge workers and IS departments. Finally we identify current and emerging research areas approachable through the pedagogical use of Web 2.0 tools in the classroom which enables the discussion of research methods, technical skills and IT/IT theory.

An Agenda for Research

The use of Web 2.0 systems in the classroom presents unique and varied opportunities for research. The platforms allow for the capture of rich and detailed data that allow both quantitative and qualitative analysis of the communications, information, and knowledge acquisition and management practices of the participants.

These platforms also allow the capture of the practices and in-situ use of these systems over time. Therefore in addition to pedagogical outcomes, researchers can study numerous aspects of group communication and dynamics, conflict resolution, technology tailoring, and even the functions of distributed groups by collaborating with students working in other institutions. Although there are significant limitations to research of university students, these environments provide expansive opportunities for a variety of research, pilot projects, and exploratory inquiry into emerging IS phenomena.

The IS and education literature contain numerous calls for increased research on the efficacy and outcomes of digital support of teaching, learning, and research (Majchrzak 2009; Scardamalia et al. 1994; Te'eni 2009). The opportunities for case research, teaching cases, and comparative outcome measures among different pedagogies are as extensive and varied as the technologies which can be used. Given the time intensive nature of developing course material, teaching cases providing technology architectures, exercises, or sample assessments would have great value in expanding the use of online tools in education. In addition, research on emerging technologies such as those outlined in the 2009 Horizon Report (Johnson et al. 2009) also provides exciting opportunities. The report identifies a number of emerging technologies likely to have a large impact on teaching, learning, research, or creative expression within learning-focused organizations. The report estimated that in the next year the use of mobile phones (e.g. iPhone apps which emulate the type of bulletin board applications on many university systems) and cloud computing will have a major impact. Other technologies predicted to become important within 2 to 3 years include the personal web (e.g. personalized web news and RSS aggregators like Netvibes.com) and location or spatial tools (e.g. Google Earth and Worldwind.arc.nasa.gov). In 4 to 5 years we find semantic-aware applications and smart objects (Internet of Things, the sensor web) predicted as high impact technologies which have bearing as IT artefacts of study and in-class use.

Challenges Facing Use

As previously noted, the time-intensive nature of developing, monitoring, and assessing digital tools can be problematic. Simply moving text materials or PowerPoint presentation onto the web is a minimal use of digital environments. We suggest that this problem will gradually diminish as tested materials and processes that can be readily implemented become more widely known. Our own experience shows that although the initial time investment is large, once tools are in use, they may require less time than traditional techniques.

Conducting research on social networking applications involves significant ethical consideration. The work of Kane and Fichman (2009) on the wider community of Wikipedia revealed the importance of recognising social norms and observing transparent operations in data collection. Certainly the conduct of in-class research requires similar consideration and sensitivity to use of data from captive audiences, the need for anonymity in published results, and the standard considerations on any type of human subject research. The use of Web 2.0 technologies in the classroom presents opportunities for large-scale longitudinal data collection, opportunities for exploration of cultural differences by collaborating with classes in other universities and the richness and detailed data collection. There exist unique possibilities for research into both pedagogy and into questions revolving around patterns of use, group interactions, knowledge creation and management and other areas surrounding these emerging technologies.

Use of these tools for learning and teaching also requires careful attention and flexibility from the faculty. For example, low participation on knowledge sharing media may diminish the quantity, consistency, and quality of shared material, thereby reducing the value of the class. Just as social network applications sometimes have low impact or activity in the real world (Te'eni 2009), class use may require intervention. Unfortunately there are no easy answers in motivating students to participate.

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